WATER QUALITY IN THE THREE SOUTH END PONDS, CUMBERLAND ISLAND, GEORGIA

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Cumberland Island, formed during the Pleistocene and Holocene, is the largest(28.2 km long X 4.8 km at its widest) and most southerly of Georgia barrier islands (Hillestad, 1975). Cumberland Island National Seashore comprises approximately 90% of the island and therefore future development is limited and preservation of its natural features is presumably assured. The island includes diverse and unique ecosystems, one of which is the South End Ponds area at its extreme southern tip. South End Ponds are three shallow interdunal ponds, which in the drought year of 1988, have been observed almost completely dry. Due to differing degrees of connection with Cumberland Sound, the ponds may be classified as palustrine aquatic bed (freshwater pond), estuarine aquatic bed (low salinity pond) and estuarine unconsolidated shore (vegetated)(high salinity pond)(Cowardin et al., 1979). Each of the ponds apparently intersects a lens of fresh groundwater whose depth fluctuates seasonally. Similar aquatic ecosystems have been observed on other Atlantic and Gulf Coast barrier islands (Mayes and List, 1988) and have been studied as systems which can be status indicators of the area hydrology and serve as habitat for many floral and faunal groups.

The present study determined the depth and surface water quality for fourteen parameters at approximately one month intervals for a year (14 Apr 88-25 Feb 89 reported to date) in each of the three South End Ponds. This baseline data will be useful in the description of such aquatic habitat in coastal Georgia and as an aid in predicting the availability of forage for the many avian species frequenting them including the wood stork, <u>Mycteria americana</u>, an endangered species.

MATERIALS AND METHODS

Three sampling stations were established in each of the ponds and standard methods were utilized to determine the following water quality parameters on surface (1-2 cm) samples (Standard Methods, 1985; Hach, 1987). Refrigerated samples were analyzed and held no longer than 48 h. Three replicate determinations were made for each parameter on every sample and the mean of these results was reported. Logistic considerations dictated that sampling was always done between 1000 and 1500 EST.

Determination	Method	Location
Pond Depth mm	Calibrated rod	Field
Water Temp. C	Potentiometric	Field
Diss. Oxygen mg/l	Membrane electrode	Field
Turbidity NTU	Nephelometric	Lab
Color Forel-Ule	Colorimetric	Field
pH	Potentiometric	Field
Conductivity micromho/cm^2	Bridge	Field
Tot. Alkalinity mg/l $CaCO_3$	Titration-indicat.	Lab
C.O.D. mg/l	K-dichrom.-H_2SO_4 reflux	Lab
Tot. Non-fil. Residue mg/l	Filtration residue/evap.	Lab
NH_3N mg/l N	Hach	Lab
NO_3N mg/l N	Hach	Lab
NO_2N mg/l N	Hach	Lab
Total ortho-P mg/l P	Hach	Lab
Salinity ppth	Potentiometric	Field

RESULTS

Based on vegetation and salinity, three pond types were established: Freshwater; low salinity and high salinity. Depth in the freshwater pond varied from 549 mm (Apr) to a 32 mm (Aug) mixture of mud and water in one small pool. Similar, but not as drastic fluctuations in water level were observed in the low and high salinity ponds. In the high salinity pond, deep (1-1.5m) "holes" were noticed at some distance from the sampling stations. Even in Aug., these locations contained water 650 mm deep. Water temperatures ranged from a low of 10 C in all ponds during Dec. to 40 C in the low salinity pond in Aug.

Values for the remaining parameters will be reported as a low and a high observation for the freshwater, low salinity and high salinity ponds respectively.

Dissolved oxygen mg/l	4.4(Jun)- 12.6(Feb) 5.3(Jun)- 13.3(Jul) 6.9(Jul)- 16.1(Jun)
Turbidity NTU	1.7(Apr)- 351(Aug) 5(Nov)- 39(Aug) 4(Nov)- 109(Jul)
Color Forel-Ule	XV(Jul)- XVIII(Nov) XV(Jul)- XVIII(Nov) Clear(Feb)- XVI(Aug)
pH	6.6(Apr)- 9.1(Jul) 6.9(Dec)- 8.8(Jul-Aug) 7.4(Jul)- 9.4(Jun)
Conductivity micromhos/cm^2	505(Apr)- 2267(Jul) 2533(Apr)- 8850(Aug) 7233(Apr)- 38100(Jun)
Alkalinity mg/l $CaCO_3$	7(Apr)- 97(Jun) 35(Jul)- 107(Nov) 32(Apr)- 107(Jul)
C.O.D. mg/l	62(Jul)- 396(Jun) 210(Jun)- 432(Nov) 90(Jul)- 520(Nov)
Tot. Non-fil. Residue mg/l	Latest data being processed
NH_3N mg/l N	0.2(Dec)- 2.5(Jun) 0.1(Dec)- 1.9(Jun) 0.1(Dec)- 5.6(Jun)
NO_3 N mg/l N	0(several)- 1.5(Jan) 0(several)- 1.5(Jul) 0(several)- 1.2(Jul)
NO_2N mg/l N	0(several)- 0.11(Jul) 0(several)- 0.005(Aug) 0(several)- 0.009(Jul)
Total ortho-P mg/l P	0.33(Jun)- 5.52(Jan) 0.07(Jun)- 1.64(Aug) 0(Jul)- 2.06(Jan)
Salinity ppth	0(most)- 1.0(Jul) 1.2(Apr)- 5.1(Jan) 4.3(Apr)- 24.3(Jun)

CONCLUSIONS

The study period has been unusual in that little precipitation has occurred during extended periods. On the other hand, so much rain fell during late Aug. and Sep. that sampling was not possible in Sep. and Oct. due to high water covering the route to the ponds. Some of the values determined during the study period would probably not be observed during a more normal year. This study is valuable, in part, due to the low water values observed for the parameters examined. In an effort to correlate water chemistry and biology in more detail, a second year of data collection is planned. During this period fishes, aquatic insects and macrophytes will be collected using quantitative and semi-quantitative methods. Diurnal variation of certain parameters such as D.O., pH and alkalinity will also be studied.

The wide range in water temperatures was not unexpected, but the mosquitofish, Gambusia affinis and several genera of aquatic insects alive in the 35-40 C medium was a surprise. The dark substrate and shallow water combined to elevate temperatures quickly beyond air temperature.

High evaporative rates and low precipitation combined to lower the ponds to levels not seen in many years (National Park Service, pers. comm.). The water table was presumably lowered at the same time. The saline ponds receive a pulse of Cumberland Sound water at least twice per year at the time of the highest spring tides. The deep holes noticed in the high salinity pond were most likely caused by alligators, Alligator mississipiensis, two of which were seen in the pond, along with numerous tracks leading to and from it.

The amount of dissolved oxygen in the ponds was usually very high. This was probably due to the large numbers of Lemna and Ceratophyllum present in the freshwater and low salinity ponds, and to the midday to afternoon sampling period. Numbers of benthic and attached algae were also high in these ponds. The high D.O. levels seen in the high salinity pond cannot be explained at present.

Turbidity levels were generally highest in the summer, probably due to suspended algae present, and to the disturbance of sediment by horses wading in the shallower water. Data on color and what we have so far analyzed of the residue support these conclusions. Turbidity values tended to be lower during the colder months.

Values for pH were high in ponds during times of peak photosynthesis. In general, the three ponds tended to be slightly alkaline.

Conductivity in the freshwater pond was quite high. Salt spray was undoubtedly one reason. Another was the high input of fecal material and urine from feral horses which frequented all ponds, but especially favored the freshwater pond. Conductivity in the other ponds varied as a result of inputs of spring tidal water. Salinity likewise mirrored the input of tidal water in the saline ponds. Spray from winter storms could also have contributed to the values observed in the low salinity pond during Jan. The 1.0 ppth value seen in July in the freshwater pond is probably related to input from the horses.

Alkalinity was generally low in all ponds.

The freshwater pond and the low salinity pond were regarded as eutrophic due to the large amounts of aquatic vegetation and waste from the feral horses. The high levels of NH_3N, NO_3N, NO_2N, PO_4 and C.O.D. reflected the eutrophic nature of these ponds. The high level of NH_3N observed in the high salinity pond may reflect the die-off and decomposition of trapped fish, and the presence of horse urine.

The South End Ponds system is important as an indicator of the state of the hydrologic system at the south end of Cumberland Island. The strong negative effect of drought, or, potentially, of increased groundwater withdrawl by nearby communities, on the South End Ponds ecosystem is clear. Many avian species use the ponds during the year, including migratory species and the endangered wood storks mentioned. Fishes and amphibians, and certain aquatic insects which provide forage for the birds will not colonize these ponds if water quality deteriorates and if the ponds are periodically dry.

The high use of the ponds by feral horses was unexpected. They use the water in the freshwater pond for drinking and eat the emergent vegetation from both the freshwater pond and the low salinity pond. They contribute fecal material and urine to all of the ponds. In addition to the effects mentioned regarding nutrient input, these animals stir up the substrate with their hoofs and create a pocked bottom. In certain areas of the ponds this creates additional turbidity and probably prevents rooted vegetation from becoming established.

Due to the extreme water level fluctuations & wide temperature extremes during the year, it is not surprising that many of the water quality parameters studied showed wide variations.

Many of the water quality characteristics noted for these ponds have been seen in other similar systems (Odum and Harvey, 1988). The continuation of this project for another year should allow even more valid comparisons with such systems.

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